CHAPTER FOUR

MANUFACTURING STRATEGY

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MANUFACTURING STRATEGY

OBJECTIVE

This chapter describes the program manufacturing strategy development within the context of acquisition strategy development. A number of manufacturing strategy alternatives will be presented to aid the PM in the strategy development and definition process. In addition, specific elements of the alternative strategies are described to establish the basis for application and their conditions for use.

INTRODUCTION

Manufacturing strategy development is a key element of acquisition strategy development. As shown in Figure 4-1, the same could be said of engineering, contracting, or logistics strategy. Integrated within the program management approach, these four disciplines are primarily responsible for achieving program goals for cost, schedule, and operational effectiveness and suitability.

Strategy and the strategic planning process should involve three major features, rational decision making, a single defined goal, and optimization. Unfortunately, these features are not typical of the planning activities in many Program Management Offices (PMOs). More often the planning and the resulting strategy results from negotiation, consensus building and adaptation to decisions and constraints imposed by Congress, DOD or Service Headquarters. The time pressures inherent in the acquisition process can also contribute to a significant reduction in the emphasis on and resources committed to developing a rational strategy.

Strategy is fundamentally a long term issue. It focuses on the clear definition of the details of the program objectives and the development of an integrated approach to achieve those objectives. Measurable goals and milestones are vital for success in executing the strategy. These goals and milestones must be supported by action plans which include the underlying assumptions, allocation of responsibility, time and resource requirements and risks.

ELEMENTS OF MANUFACTURING STRATEGY

A manufacturing strategy is a detailed plan for assuring timely and cost effective production of an item which meets all operational effectiveness and suitability requirements. To be effective the strategy must be developed in consonance with program engineering, contracting, and logistics strategies, considering current and projected constraints, risks, and opportunities in the industrial-technological base. Key elements of consideration are identified in Figure 4-2.

Manufacturing strategy development must begin during the earliest stages of system development. Acquisition decisions such as system design approach and production rate are intimately intertwined with manufacturing strategy. Manufacturing strategy will affect design and production rate decisions. Design and production rate decisions will affect manufacturing strategy.

While only the most general definition of manufacturing strategy may be possible during the early stages of system development, this general definition will provide a foundation for early acquisition decisions and for later, more detailed, strategy definition. The manufacturing strategy must be flexible enough to identify and adapt to changes in the product and the manufacturing environment. Changing constraints, risks, and opportunities can affect even mature system production.

Clear manufacturing strategy development will affect government and contractor actions. Both government and contractor management will be motivated to adopt options that minimize the effect of manufacturing constraints and risks and pursue beneficial manufacturing opportunities.

Figure 4-3 lists the major elements of the manufacturing strategy for a particular program. For each element in the strategy, decisions must be made relatively early in the acquisition process to ensure that the required actions are taken in a timely manner. Tradeoffs are made, often within the context of the development of the program acquisition strategy. Each element has associated with it a set of costs and risks which need to be assessed against the specific program realities and technological challenges. Detailed discussion of each of these topics is provided elsewhere in this Guide, but the major decision issues in the strategy development process are described below.

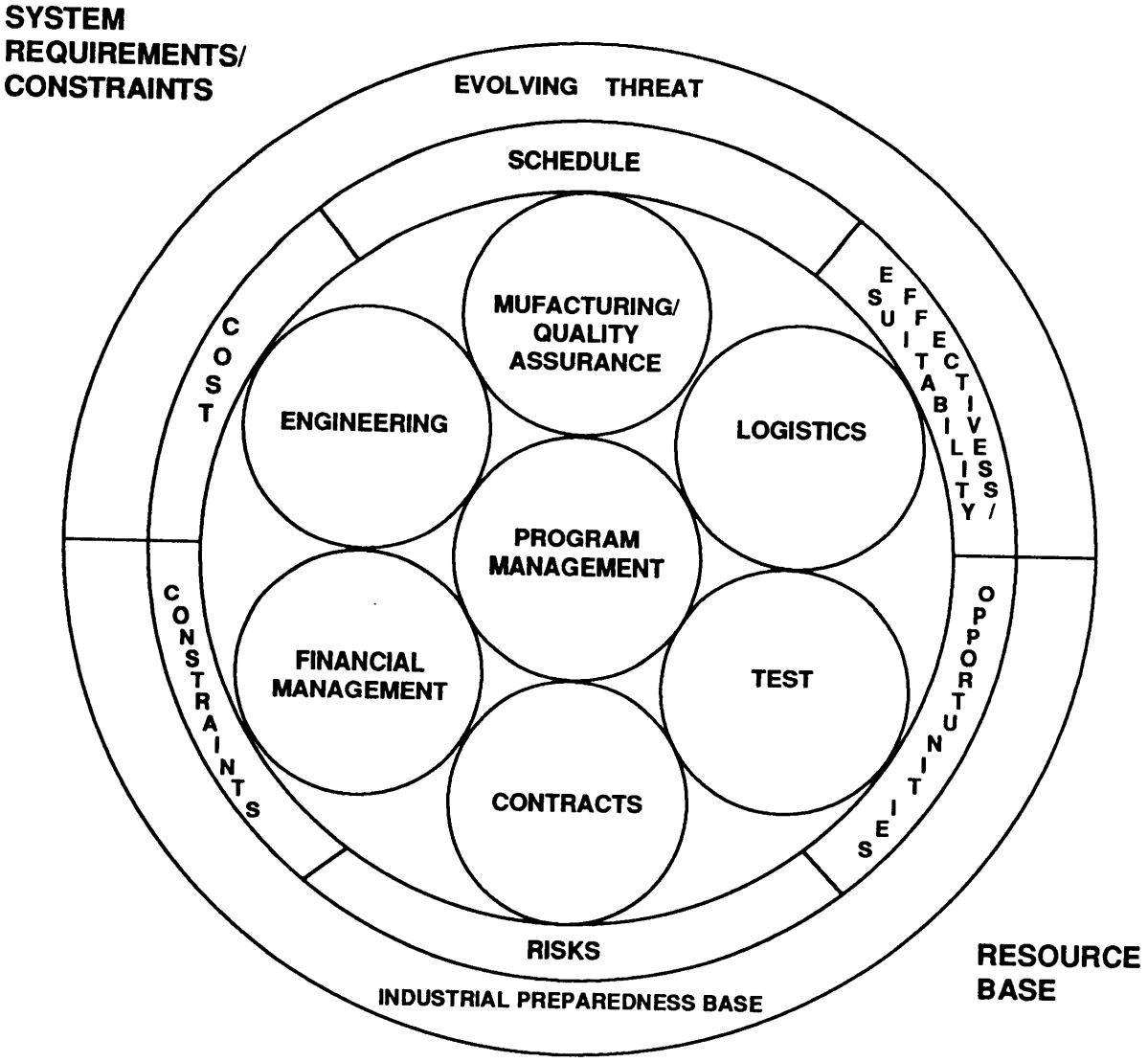

Figure 4-1 Systems Acquisition Strategic Environment

Normally certain decisions are already made and serve as input to the strategy development process shown in Figure 4-4. The system to be developed and produced is described to some level of detail and some of the major milestones such as Initial Operational Capability are established. The total quantity to be produced and the estimated total funds forecast to be available are often established. Within these constraints, the detailed strategy is developed.

Production Competition

Decisions must be made on whether to utilize more than one source for manufacturing during the production phase. Normally, competition in this phase will act to reduce recurring manufacturing cost. The trade off is the increased non-recurring cost to establish the other source(s). Schedule and technical risk are reduced with multiple sources; however, the problem of end item variability is increased.

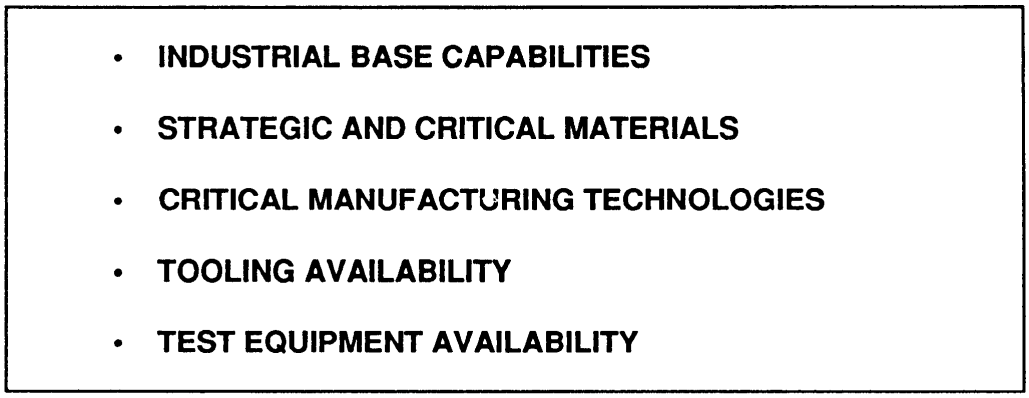

Figure 4-2 Manufacturing Constraints and Risks

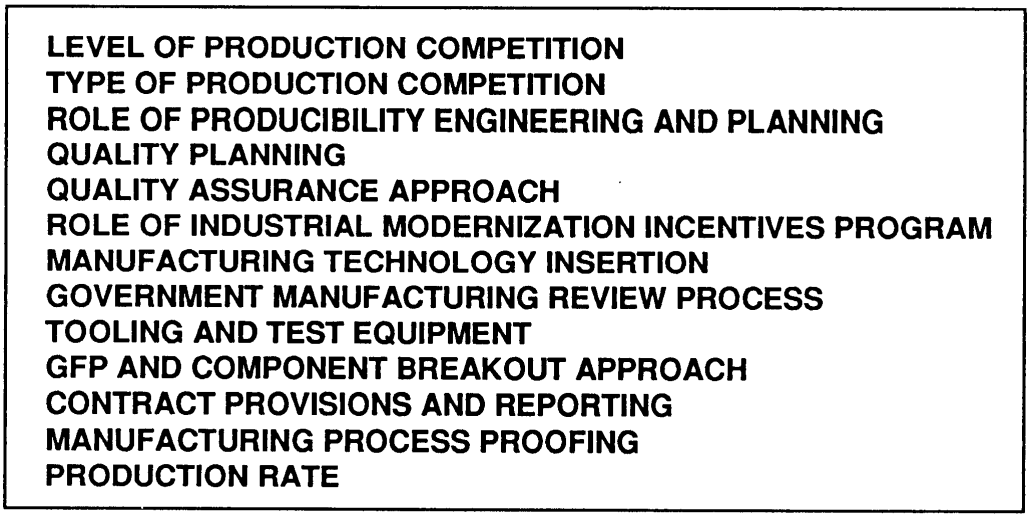

Figure 4-3 Elements of Manufacturing Strategy

Producibility Engineering and Planning

Decisions must be made on the structure and funding levels of the formal Producibility Engineering and Planning (PEP) program. The timing of initial formal Producibility Engineering and Planning (PEP) actions must be established and the objectives for the contracts in each acquisition phase need be determined. The activities in each acquisition phase need to build on the preceding activities and set the foundation for transition from develop-

ment to production.

Quality Planning and Approach

The manufacturing approach to meeting TQM objectives must be defined. Early action by manufacturing is necessary to obtain optimum quality in the delivered system by ensuring that the constraints of materials and processes are explicitly considered.

Industrial Modernization Incentives and Manufacturing Technology

The Industrial Modernization Incentives Program (IMIP) and the Manufacturing Technology (MANTECH) Program are separate sub elements of industrial preparedness. Both programs seek to assure productivity, readiness and responsiveness of the defense industrial base through modernization of the manufacturing and management processes of the enterprise.

MANTECH focuses on advancing state-of-the-art manufacturing technologies and processes from the research and development environment (laboratory) to the production and shop floor environment. Technologies with generic application required for defense systems and having high technical and financial risk characterize the projects with the highest priority for MANTECH funding. MANTECH projects demonstrate production application of emerging technologies. Proven technologies resulting from the MANTECH program are candidates for implementation under IMIP.

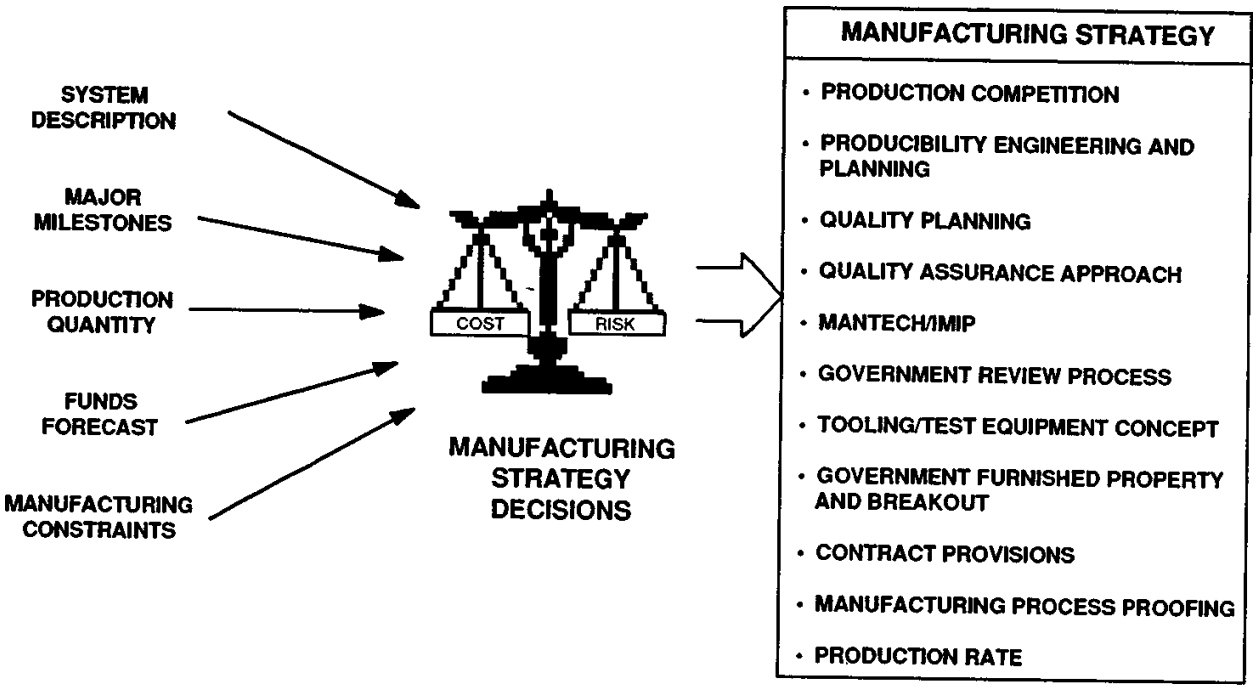

Figure 4-4 Manufacturing Strategy Decisions

IMIP aims at improvements on a factory-wide basis by providing industrial incentives for modernizing the total enterprise through implementation of well established and proven state-of-the-art technologies. Although many IMIP projects have been established on an individual weapon system program basis, the government's preference is for a factory-wide approach that is applicable to all weapon systems and DOD product lines within the enterprise because it offers the greatest potential benefit to the DOD. Perhaps the most important distinction of IMIP is that it uses a business agreement to accelerate implementation of modern manufacturing technology across product lines and production contracts. IMIP couples contractual incentives with technology implementation.

MANTECH and IMIP work together to enhance productivity, reduce weapon system cost, improve industrial base capacity, and capability peacetime, surge and mobilization.

Government Review Process

Decisions need to be made concerning the amount of PMO and other government involvement during the life of the program. These decisions include the type and quantity of data items, on-site reviews, and issues and contractor decisions which will require PMO or other government organization approval. In addition to identifying the government reviews, initial decisions need to be made on the depth and extent of the reviews to serve as a basis for contractor and government resource planning.

Tooling/Test Equipment Concept

The general guidelines for planning for tooling and test equipment need to be established. The issues include contractor investment, the level of rate tooling and test equipment to be utilized, the transition from limited life to rate tools and the degree of similarity between production test equipment and depot test equipment to be required. Also, guidelines for maintaining tools and test equipment need to be set forth.

Government Furnished Property and Breakout

Providing equipment or subsystems to the prime contractor as Government Furnished Property (GFP) may reduce the acquisition cost and contribute to greater commonalty in deployed systems. There is however, a corresponding shift of responsibility for system performance and delivery from the contractor to the government. Consideration needs also to be given to the potential for later breakout of equipment of subsystems from Contractor Furnished Equipment (CFE) to GFP.

Contract Provisions

Each of the choices made in developing the manufacturing strategy must be supported by selection or development of appropriate contract clauses. Where specific actions may be planned for later phases for the acquisition process, it is often necessary to include enabling or planning provisions in the earlier phase contracts to create the proper environment and relationship for the later actions.

Manufacturing Process Proofing

The manufacturing strategy should include the criteria for determining which production processes will require proofing and the timing of such proofing activity. Process proofing can make a major contribution to risk reduction, but it may involve cost and/or potential schedule impacts during the development phase.

Production Rate

While the production rate will be constrained by the available funds profile, some allowance for variation

may remain, In addition, total program cost may be significantly impacted by changes in production rate. These impacts need to be assessed and presented to the involved decision makers.

Type of Production Competition

Part of strategy development involves definition of the long term relationship between contractors and the government. Research and field experience indicate that competition between contractors can provide real benefits by encouraging contractor innovation and cost reduction. At the same time, a true strategic approach implies a long term partnership. Several approaches have been used to balance these apparent conflicts in development of a strategic government/contractor approach to system development and production. These approaches include: leader/follower contracting; component breakout, multi-year contracting, and industrial modernization incentive utilization.

DESIGN COMPETITION

Requirements should be delineated in both quantitative and qualitative terms at lower levels of detail as product development unfolds. Further requirements should always precede functional or physical means, which should then be designed or selected to satisfy the requirements.

It must be economically feasible to manufacture a quality product at a specified rate and to deliver end items capable of achieving the performance and reliability inherent in the design. This design requirement is not always well understood and historically has taken a back seat to the more popular objective of high performance. The results of this neglect have ranged from factory rework rates in excess of 50 percent to suspension of government acceptance of end items pending major redesign for producibility. A strong producibility emphasis early in design will minimize the time and cost required for successful transition to production.

DOD 4245.7-M, Transition from Development to Production specifically identifies the importance of the design disciplines enumerated in Figure 4-5. Contractor performance in these disciplines should be an important source selection evaluation criterion. Accordingly, competition should be maintained in the acquisition process until contractor performance in these critical design disciplines can be properly assessed.

DOD 4245.7-M and NAVSO P-6071, Best Practices, provide general guidelines which may be used in developing criteria for design effort evaluation. Specific criteria must be tailored to individual system requirements.

A high risk of acquisition program failure is always present at the outset of the design process. While some levels of risk associated with a new technical concept may be unavoidable, historically this risk has been magnified by the misunderstanding of the industrial design disciplines necessary to turn the concept into a mature product. The government and its contractors must share equal responsibility for this misunderstanding. The contractor's proposal and government source selection process provide the last cost-effective opportunity to ensure application of these critical disciplines during design and the achievement of design maturity.

LEADER/FOLLOWER CONTRACTING

Leader/follower contracting is a technique under which the developer or sole producer (leader company) of a product furnishes manufacturing assistance and know-how or otherwise enables another source (the follower

company) to become a supplier of the product. This procurement method is sometimes referred to as “second sourcing,” or leader company procurement.

Objectives of Leader/Follower Contracting

The objectives presented in Figure 4-6 represent a general outline of the elements that must be evaluated in considering the use of leader/follower contracting. Consideration of these objectives and individual program differences is essential to successful application of this approach. Vital program considerations include: supply restrictions; manufacturing quantities; program relationship to other programs; and potential improvement of product quality and/or cost reduction from the introduction of competition. Consideration of the relationship between program requirements, funding, and economic production quantities is vital, particularly when only small quantities are required.There are several policy limitations to be considered by the program manager. For example, leader/follower contracting should be used only when the circumstances identified in Figure 4-7 are present.

Approaches

Several contractual approaches are available including:

1. Awarding a prime contract to the leader company which obligates the leader to subcontract a designated portion of the total number of end items to the follower company and to assist the follower in manufacturing.

2. Parallel production wherein two separate prime contracts are awarded. The leader company prime contract would contain a requirement that it provide the requisite assistance to the follower company for manufacturing of the items.

3. Designating the follower company as the prime contractor for the production of items, under which the follower company is obligated to subcontract with a specific leader company for the requisite know-how.

- DESIGN REFERENCE MISSION PROFILE IDENTIFICATION
- DESIGN REQUIREMENTS IDENTIFICATION
- TRADE-OFF STUDIES
- DESIGN POLICY DOCUMENTATION AND USE
- DESIGN PROCESS CONSIDERATION OF MANUFACTURING AND OPERATIONS
- DESIGN ANALYSIS INCLUDING STRESS AND STRENGTH ANALYSIS
- PARTS AND MATERIALS SELECTION CONSIDERING SPECIAL SYSTEM REQUIREMENTS
- SOFTWARE FUNCTION AND LOGIC DESIGN ANALYSIS
- COMPUTER AIDED DESIGN UTILIZATION
- DESIGN-FOR-TESTING
- CONFIGURATION CONTROL
- DESIGN REVIEW DISCIPLINE
- REALISTIC DESIGN RELEASE SCHEDULING

Figure 4-5 Critical Design Disciplines

Certain factors should be considered in utilizing this acquisition strategy. It may be difficult if not impossible to maintain leader company commitment to the technology transfer without a contractually binding arrangement. Thus, if a program encounters delays or slippages because of funding or requirements changes, leader company decisions to reallocate resources to other government programs or commercial markets may seriously impact the program. This is especially pertinent if a follower company is experiencing technical problems. Maintaining control of the leader firm may be particularly difficult when the leader company is a subcontractor. Since the government has no direct contractual relationship with the leader, if a problem develops, the government's only recourse is through the follower (prime) company.

A second factor concerns the Technical Data Package (TDP). In many cases, the completeness of the TDP will be a function of the technology involved and the government's ability to both accurately state its data requirements and maintain configuration control. This implies a cost which the government must assume and is similar to costs associated with commercial practices involving licensing arrangements, joint ventures, or teaming.

A 1988 DOD Inspector General report identified cost estimating and analysis problems which have been encountered with dual source programs. Their findings indicate that the potential savings are overestimated by the cost-benefit analysis methods currently in use. They also determined that these estimates do not always consider all the pertinent costs. When developing a strategy for dual sourcing, the PM should ensure that the structure of the program is such that competition will be effective (i.e. the "loser" in a split buy does not get too high a percentage of the work). In addition, careful analysis of the full cost for implementing and maintaining the competitive environment should be accomplished, with special emphasis on the non-recurring costs to reach an effective competitive status. Systems should be in place to monitor the costs of dual sourcing for comparison with estimates and for use in evaluating potential changes to the acquisition strategy.

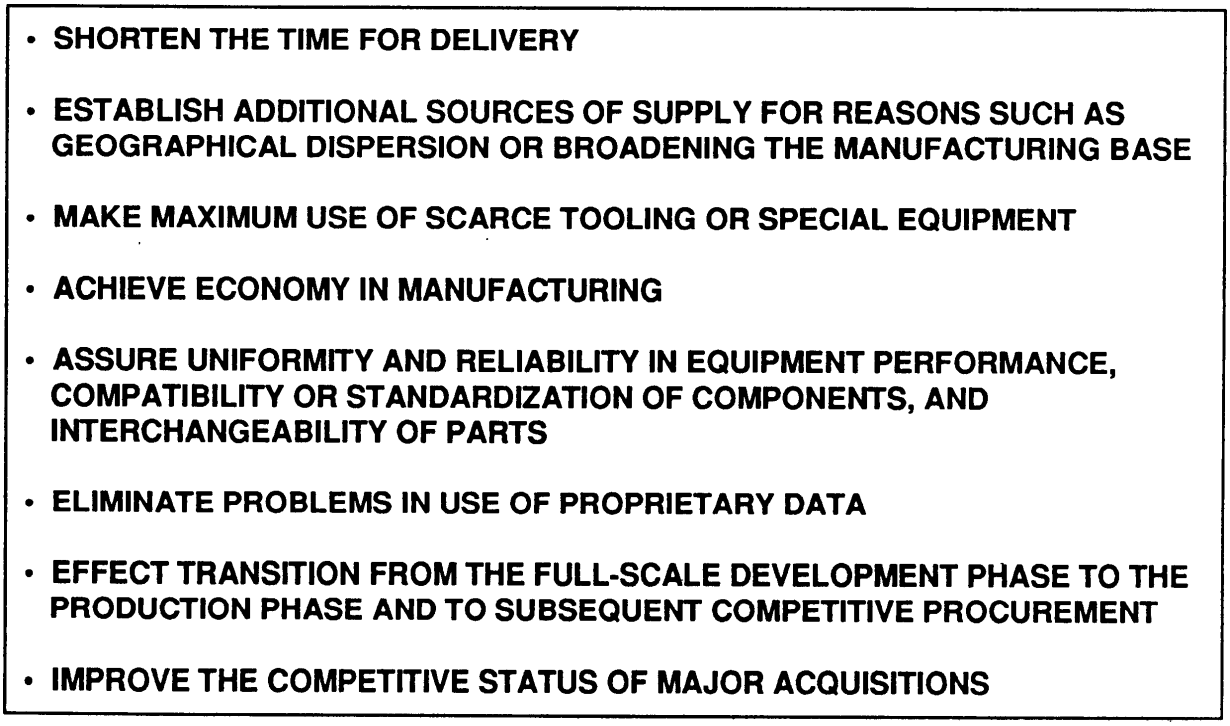

Figure 4-6 General Leader/Follower Contracting Objectives

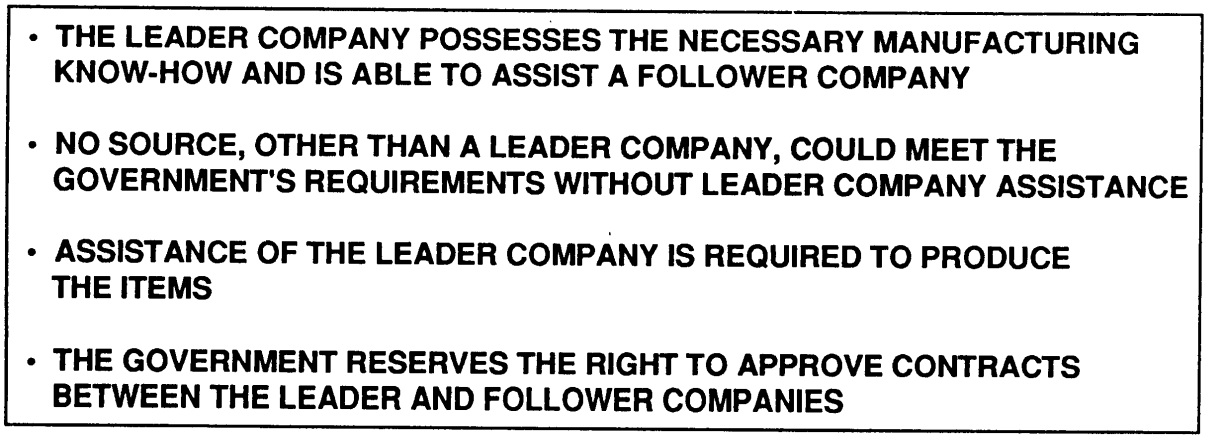

Figure 4-7 Leader/Follower Conditions for Use

COMPONENT BREAKOUT

The term “component breakout” can be defined as a program management decision of whether or not subsystems, assemblies, subassemblies, and other major elements of end items or systems should be purchased

directly by the government and provided to the prime contractor as government furnished material. Here, consideration of component breakout will be limited to components that have been contractor-furnished material in a previous system buy. The approved and current acquisition plan should identify those milestones at which component breakout decisions should be made. These decisions include those which must be made early in the contracting cycle on such matters as initial program support levels of government furnished versus contractor furnished equipment and the contract provisions covering spare parts provisioning.

Objectives of Component Breakout

Whenever a prime contract for a weapons system or other major end item will be awarded without adequate price competition and the prime contractor acquires components without such competition, DOD policy is to break out those components if substantial net cost savings can be obtained without jeopardizing the quality, reliability, performance or timely delivery of the end item. Additionally, the desirability of component breakout should also be considered whenever substantial net cost savings will result from greater quantity purchases or improved logistics support. Component breakout also provides a firm basis for later direct purchase or competitive purchase of the required spare and repair parts.

Breakout Issues

There are many issues of importance to the program manager in the implementation of a component breakout program. How are breakout candidates to be identified? What logistics system risks are involved? How will economic and quantity change factors influence cost? What responsibilities will the government share or assume as a result of providing government-furnished components? Will the item be purchased competitively or on a sole source basis? The answers to these questions cross many disciplines including production, engineering, finance, and contract administration. Most weapon systems involve relatively large numbers of end items procured over the program life cycle which often extends over a number of years.

Guidelines

The program manager should base each component breakout decision on an assessment of the potential risks of degrading the end item through such contingencies as delayed delivery and reduced reliability of the component, calculation of estimated net cost savings over the program life cycle, and analysis of the technical, operational, logistic and administrative factors involved. Particular emphasis should be placed on assessing the stability of the design, the availability of item data required to support the breakout decision, and the ability of the government to transfer the design description to a potential source.

MULTI-YEAR CONTRACTING

A multi-year contract is a contract covering planned DOD requirements for an item for up to 5 years. In most cases, the contract is funded for only one year at a time. The contractor is protected against loss resulting from cancellation by contract provisions which allow reimbursement of costs included in a cancellation ceiling. This cancellation ceiling covers only nonrecurring costs, such as equipment investment which would have been amortized over the life of the contract. This technique offers significant potential for cost savings by enhancing program stability and providing contractors with the capability to optimize schedules, stabilize their workforce, purchase economic lot buys of material, and plan for investing in cost reducing capital improvements. Although multi-year contracts can benefit the government by saving money and improving contractor productivity, it can also entail certain risks, including increased cost to the government, should a multi-year contract later be changed or terminated.

Multi-Year Contracting Objectives

Multi-year contracting is encouraged to take advantage of one or more of the objectives presented in Figure 4-8.

In general, the primary objective for multi-year contracting is the potential for lower weapon system costs. Estimates of potential savings have been made in the range of 10 to 30 percent. Experience indicates that specific savings are difficult to calculate but that savings of 10 to 15 percent appear to be reasonable.

Guidelines

Multi-year contracting may be used when Congress authorizes funds for up to five years for the procurement of specified quantities. Although appropriations are still granted annually, the service agreements with the congressional committees almost guarantees the multi-year procurement (MYP) term and allows significant advanced procurement of long lead items. Multi-year contracting must make it possible to attain one or more of the objectives in Figure 4-8 where all the criteria in Figure 4-9 are present.

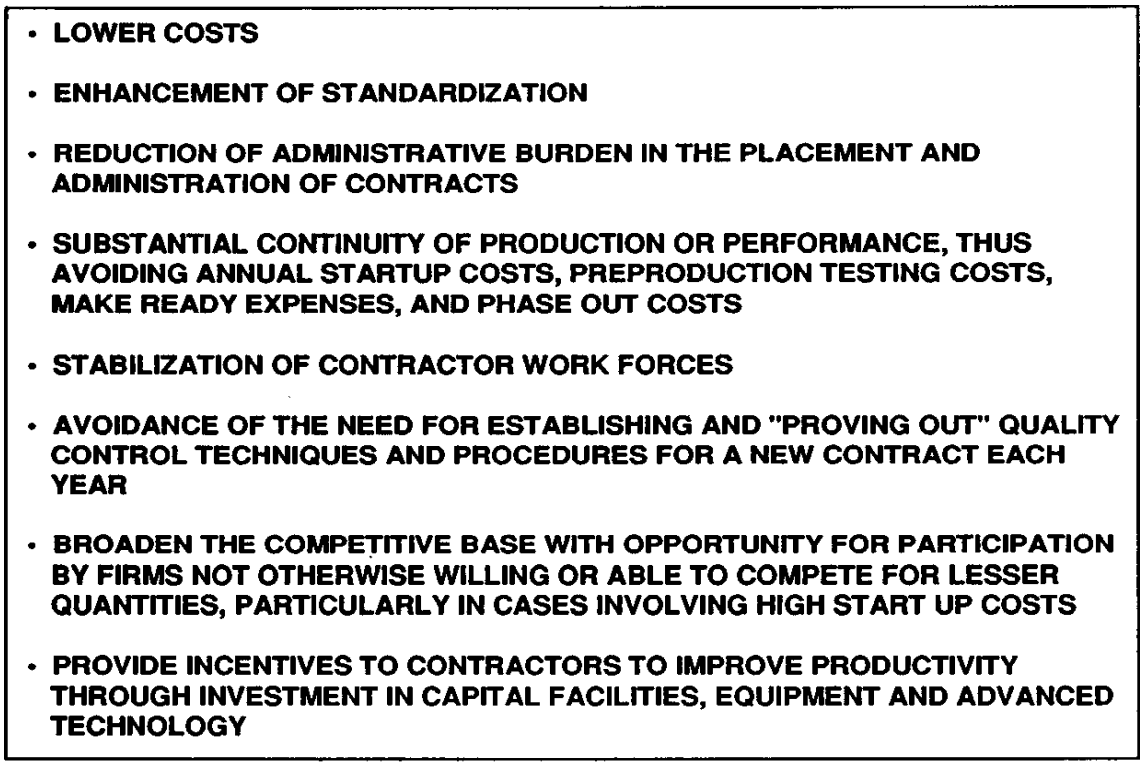

Figure 4-8 Multi-Year Contracting Objectives

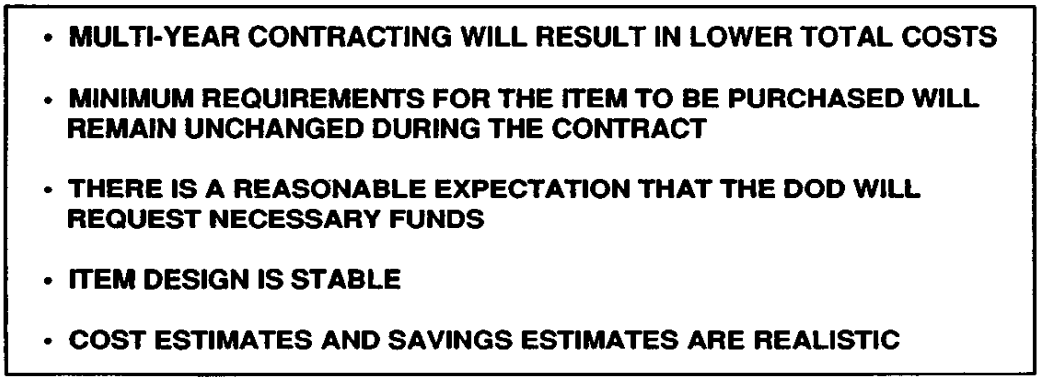

Figure 4-9 Multi-Year Contracting Criteria

INDUSTRIAL MODERNIZATION INCENTIVES PROGRAM

The Industrial Modernization Incentives Program (IMIP) is an example of government/contractor partnership for mutual strategic benefit. Industrial modernization incentives may be negotiated and included in contracts for research, development, and/or production of weapons systems, major components, or material. The

purpose is to motivate the contractor to invest in facilities modernization and to undertake related productivity improvement efforts that it would not have otherwise undertaken or to invest earlier than it would otherwise would have done. Incentives may be in the form of productivity savings rewards, contractor investment protection, and/or other appropriate forms. They may be used separately or in combination. Contractor investment protection by government assumptionof part of the investment risk is the cornerstone of IMIP. Program details including, specific goals and limitation are presented in Chapter 8.